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Distribution and Abundance of Winter Populations of Bald Eagles in Illinois

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Cover Photo: The bald eagle, *Haliaeetus leucocephalus*, as photographed by Steven Holt/VIREO.

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DISTRIBUTION AND ABUNDANCE OF WINTER POPULATIONS OF BALD EAGLES IN ILLINOIS

Stephen P. Havera and Glen W. Kruse

The bald eagle (*Haliaeetus leucocephalus*) is the only sea or fishing eagle that inhabits North America. Seven additional members of this genus occur in other parts of the world (Brown & Amadon 1968). Names sometimes applied to the bald eagle include American eagle, white-headed eagle, and Washington's eagle. Immature bald eagles have been called black eagles because of their dark color (Terres 1980).

In recent years, the numbers of bald eagles in North America have rebounded from the critically low levels that resulted from loss of habitat, illegal shooting, and the widespread use of certain persistent pesticides. Illinois is currently an important winter area for bald eagles.

DESCRIPTION

Among the largest birds of North America, the bald eagle has an average body length of 34 to 43 in (85–109 cm) and a wingspan that is generally 6 to 7 ft (2.0–2.4 m). Robards (1967) reported wingspans of 78 to 93 in (1.98–2.36 m) for 39 eagles captured in Alaska. As in most raptors, female bald eagles are larger and heavier than males with the average weights of females ranging between 10 and 14 lb (4.5–6.4 kg) as compared with weights for males between 8 and 9 lb (3.6–4.1 kg) (Imler & Kalmbach 1955). Weights as high as 16.5 lb (7.5 kg) were reported by Robards (1967). Birds trapped in Minnesota weighed 8.6 to 13.2 lb (3.9–6.0 kg) (Hennes 1985).

Although different immature and subadult plumages of bald eagles occur, these plumages are mostly dark brown with irregular patches of white on the underside of the wings or elsewhere on the body (Clark 1983) (Fig. 1). For the purposes of this study, juvenile, immature, and subadult eagles were grouped into the immature age class because subtle differences in these plumages were difficult to discern during aerial inventories. The bill of an immature is brown, the eyes are pale yellow-gray, and the feet are lemon yellow. Immature bald eagles are distinguished from immature golden eagles by their larger heads, heavier bills, and unfeathered legs (Terres 1980).

At 4 to 5 years of age, bald eagles attain the familiar adult plumage consisting of a dark brown body with pure white head and tail (Fig. 2). The bills, eyes, and feet of adult bald eagles are bright yellow (Terres 1980).

DISTRIBUTION

Two populations of bald eagles, the northern and southern, have been described in North America. Based on a slight difference in size, these populations have been designated as subspecies with the northern population denoted as *H. l. alascanus* and the southern group as *H. l. leucocephalus*. For purposes of management and legal protection, these two populations are treated as one because of overlapping ranges in the nonbreeding season.

Historically, the northern population of bald eagles bred from Bering Island, the Aleutian Islands, northwestern Alaska, Mackenzie, Manitoba, central Ontario, southeastern Quebec, Labrador, and the coasts of Newfoundland southward to southern Oregon, Idaho, Wyoming, Colorado, South Dakota, Minnesota, Wisconsin, Michigan, Ohio, Pennsylvania, New Jersey, and Maryland. Breeding still occurs in Maine, the Chesapeake Bay area, the Upper Peninsula of Michigan, northern Wisconsin, Minnesota, northern Idaho, Oregon, Washington, Alaska, Saskatchewan, Manitoba, and northern Ontario (Evans 1982).

The southern population once bred from northern California southward to both coasts of Baja California, central Arizona, New Mexico, western Nevada, and southern Utah, and from northern Texas, Oklahoma, Missouri, Iowa, southern Illinois, western Kentucky, and Virginia south to the Gulf Coast of Florida. This population now breeds primarily in Florida with some nesting occurring in Louisiana, Texas, California, and Arizona (Evans 1982).

During the nonbreeding season, the northern birds can be found from Alaska, northern Mackenzie, southern Ontario, Quebec, and southern Nova Scotia to the southern United States. Some southern birds may wander northward in their nonbreeding season (Evans 1982).

POPULATION LEVELS

The U.S. Fish and Wildlife Service (USFWS) and private conservation organizations have estimated the number of bald eagles present in the 48 contiguous

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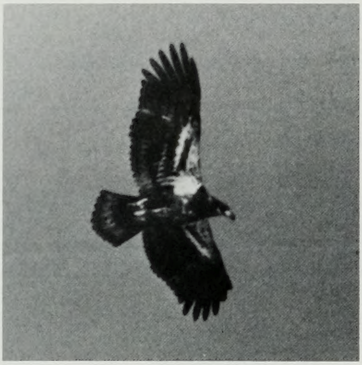

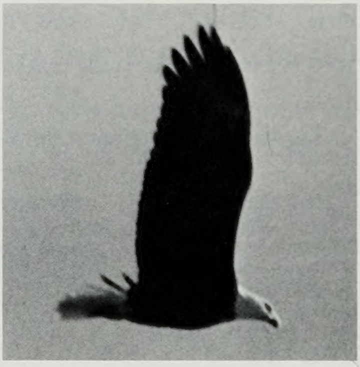

Fig. 1.–Immature bald eagle in flight (Photo by David L. Fischer).

Fig. 2.–Adult bald eagle searching for prey (Photo by David L. Fischer).

states during winter. The difficulty of coordinating a census over such a large area has resulted in counts that provide only an index to actual population levels.

Nationwide bald eagle censuses have shown a dramatic increase since the late 1970s (Table 1). The increase is attributed partially to more effective counts. Until 1976, counts were the result of incidental eagle sightings during a USFWS January waterfowl inventory. In 1979, the National Wildlife Federation (NWF) organized an annual midwinter bald eagle survey. Thousands of persons are currently involved in the enumeration of bald eagles.

Although variation in geographical coverage of the midwinter bald eagle surveys among years makes accurate counts difficult, bald eagles appeared to have reached their highest number of 13,825 in 1982 (Table 1). Millsap (1986) noted that a reasonable estimate of the midwinter population of bald eagles for the lower 48 states during the early 1980s was 14,000–22,000 birds. A decline in numbers observed on the midwinter survey has occurred since 1982 (Table 1).

Table 1.—Number of bald eagles in the contiguous United States during January, 1961–1986.

Year	Number Counted	Reference
1961	3,642	Sprunt and Ligas 1963
1962	3,807	Sprunt and Ligas 1963
1963	3,547	Sprunt and Ligas 1963
1971	2,490	USFWS unpublished[a]
1972	2,668	USFWS unpublished[a]
1973	2,986	USFWS unpublished[a]
1974	3,553	USFWS unpublished[a]
1975	3,580	USFWS unpublished[a]
1976	4,478	USFWS unpublished[a]
1979	9,815	NWF (1985)
1980	13,046	NWF (1985)
1981	13,689	NWF (1985)
1982	13,825	NWF (1985)
1983	12,098	NWF (1985)
1984	11,819	NWF (1985)
1985	10,985	NWF (1985)
1986	8,318	NWF[b]

[a] Steenhof (1976).

[b] Personal communication.

The 1985 estimate of the breeding population of bald eagles in the United States was approximately 5,000 pairs with about 1,770 pairs nesting in the conterminous 48 states and the remainder in Alaska (USFWS 1986). Approximately 500 nesting pairs occurred in the lower 48 states in the early 1960s (NWF 1987). Braun et al. (1975) suggested that the downward trend in the reproductive success of bald eagles that resulted from persistent pesticides had slowed dramatically by 1975. Surveys of the breeding population of bald eagles conducted in 1982 and again in 1985 indicated that the number of breeding pairs in the lower 48 states increased about 6% per year during this period (USFWS 1986).

LIFE HISTORY

Reproduction

Most eagle nests are built in trees from 10 to 150 ft (3–46 m) above the ground (Terres 1980). Nests are made of sticks, mosses, pine needles, grasses, and feathers and are the largest nests built by a single pair of birds, commonly 6 ft (1.8 m) wide and 6 ft (1.8 m) deep and occasionally as much as 20 ft (6.1 m) wide and 9.5 ft (2.9 m) deep (Brown 1977). Both sexes participate in nest building. The same nest may be used for 10 to 30 years with new material added every year (Brown 1977).

One to three, usually two, dull-white eggs are laid during November to January in Florida and during March to May in the northern range (Terres 1980). Both sexes incubate the eggs, but the female assumes the greater share of the incubation duty, which lasts for approximately 35 days (Brown 1977). Incubation begins with the laying of the first egg; therefore, the sequential hatching of eggs results in chicks of different sizes. Smaller and weaker chicks often die from starvation or are killed and eaten by the older, larger chicks (Terres 1980). Newly hatched bald eagle chicks are covered with white or gray down, which is replaced by thicker gray down at 2 to 3 weeks of age. Feathers begin to appear at 4 to 5 weeks. Young birds fledge in 72 to 75 days.

Mortality

Mortality of subadult bald eagles is high. Sherrod et al. (1976) found that mortality of subadult bald eagles in Alaska was approximately 90% through their first 3 years. Death resulted from limited food supply and starvation complicated by the lower rate of success as predators for subadult eagles. Mortality for adults appeared to be low and ranged from 5 to 10% per year (Sherrod et al. 1976). The longevity record for a banded wild bald eagle is 21 years 11 months at the time of recapture (Cain 1986).

The causes of mortality among bald eagles are closely monitored. In recent years, the Patuxent Wildlife Research Center and the National Wildlife Health Laboratory (NWHL) have been responsible for determining the causes of death from eagle carcasses found in the United States. Between 1963 and 1984, 1,429 bald eagle carcasses were submitted to the NWHL for necropsy. Although the results of the postmortem examinations (Table 2) may not represent the actual proportional causes of mortality because of sampling bias, the data serve to demonstrate the most common known causes of mortality (NWHL 1985).

Table 2.—Summary of causes of death of 1,429 bald eagles, nationwide from 1963–1984 (National Wildlife Health Laboratory 1985).

Cause of Death	Number of Deaths	Percent of Total
Gunshot	329	23.0
Trauma (excluding gunshot, electrocution, and trapping)	301	21.1
Electrocution	130	9.1
Emaciation	110	7.7
Poisoning (excluding lead)	75	5.2
Lead poisoning	83	5.8
Trapping	68	4.8
Disease	31	2.2
Other	43	3.1
No diagnosis	259	18.0

At least one of the 1,429 eagles examined was found in each state except Hawaii and New Hampshire. Some states reported numerous incidents of eagle mortality, including Alaska (228), Wisconsin (159), Minnesota (120), and Florida (107). Twenty-five or more dead eagles were found in each of 20 states (NWHL 1985).

Of the 158 deaths attributed to poisoning (Table 2), 83 (52.5%) were a result of lead poisoning. All available evidence indicates that bald eagles are exposed to the toxic effects of lead when they feed on waterfowl that have lead shot embedded in their flesh or present in their digestive tracts (NWHL 1985). Many eagles winter on wildlife refuges where crippled, sick, and dead waterfowl are a major portion of the diet (Sabine & Klimstra 1985, Hennes 1985, Keister et al. 1987).

Confirmations of lead poisoning as a substantial mortality factor for bald eagles have prompted the enactment of protective regulations. As a result of a lawsuit filed by the NWF, a federal judge ordered the closing of 30 counties in 8 states to waterfowl hunting during the 1985–1986 season unless nontoxic shot was used (U.S. Dept. of Interior 1985). The USFWS expanded the prohibition of lead shot to include a total of 173 counties in 26 states for the 1986–1987 waterfowl hunting season (U.S. Dept. of Interior 1986) and has proposed a nationwide ban on the use of lead shot for the hunting of waterfowl by the 1991–1992 season (USFWS 1986). Such restrictions on the use of lead shot eventually will reduce the availability of lead to bald eagles and the subsequent sublethal and lethal effects that result from ingestion of lead pellets.

LEGAL STATUS

The bald eagle has been a protected species in the United States since the establishment of the Bald Eagle Protection Act in 1940. The act provides a fine of up to $10,000 and a prison term of up to 2 years for a violator and prohibits the taking, possession, sale, purchase, barter, offer to sell, transport, and export or import of any bald eagle, alive or dead, including any part, nest, or egg, unless allowed by permit.

Other federal laws that protect the bald eagle include the Migratory Bird Treaty Act, the Endangered Species Act, the Lacey Act, and the Airborne Hunting Act. The bald eagle is listed as endangered in 43 states and threatened in 5 other states (Mendoza 1984).

BALD EAGLES IN ILLINOIS

Historical Records, 1200–1950

Bald eagles have been present in what is now Illinois for thousands of years. The first documented presence of eagles dates back 400 to 800 years based upon the remains of at least 16 bald eagles identified by Parmalee (1958) from Indian burial sites at Cahokia. The predominance of bones associated with the primary wing feathers suggested that eagle feathers were used for symbolic or ceremonial purposes.

Reports of bald eagle sightings in Illinois during the late nineteenth and early twentieth centuries are mostly anecdotal accounts in newspapers and ornithological journals. Apparently, the sighting of an eagle in most parts of the state during this period was of sufficient rarity to be considered newsworthy.

Ridgway (1889) listed the bald eagle as "a summer resident of general distribution" that was "more or less common" along the larger waterways. The mention of summer residency suggests that bald eagles nested in Illinois in the late 1800s.

Only a few years after Ridgway's account was published, Gault (1896) expressed surprise at seeing a bald eagle near Melrose Park in Cook County. He considered the eagle a "rare transient" and was particularly surprised to see the bird on April 28, an unusually late date for eagles to be in that area.

The first bald eagle reported on the Audubon Christmas bird count was in 1914 at Hinsdale, Illinois (Anon. 1915). Two bald eagles were seen and killed near Rantoul in Champaign County in May of 1918. The previously reported sighting of eagles in that area was in 1915 (Ekblaw 1918).

Pellett (1927) reported that he saw two or more bald eagles frequently on the Mississippi River between Keokuk, Iowa, and Warsaw, Illinois, during the winter of 1925–1926. He estimated that eight eagles were killed by hunters in that area during the same winter.

The bald eagle appeared rarely in the Chicago region during the late 1920s. Ford et al. (1934) reported sightings in February 1924, December 1928, and January 1930.

The Ohio and Wabash river valleys have generally been considered unimportant as eagle habitat, but Bonnell (1935) reported scattered sightings and shootings of eagles in these areas between 1910 and 1934.

Musselman (1942) noted the killing of at least 11 eagles in the vicinity of Lock and Dam 19 at Keokuk on the Mississippi River between 1929 and 1938. Musselman often sighted 12 to 18 eagles in this area in the late 1930s. The mayor of Henry in Marshall County shot and killed an immature bald eagle in November 1939 near Henry (Barnes 1939).

Bellrose (1944) reported nesting by bald eagles near Henry every year from 1935 to 1940 and at Horseshoe Lake in Alexander County from 1941 to 1943. Until that time, nesting had not been reported in Illinois since 1915, when a pair nested in Piatt County. These were possibly the same birds reported from Champaign County by Ekblaw (1918).

Observations by Musselman indicate that increasing numbers of eagles utilized the Mississippi River near Lock and Dam 19 during the 1940s. Twenty-five to 30 eagles often were seen during the winter of 1944–1945 (Musselman 1945) and as many as 83 birds were sighted in the winter of 1947–1948 (Musselman 1949).

There was also an increase in the numbers of eagles sighted near the Illinois River. Yeager (1950) observed at least 12 eagles at Chautauqua National Wildlife Refuge in January 1943.

Recent Records

Historically, the bottomlands near the confluences of the Missouri, Ohio, and Mississippi rivers were major nesting areas for bald eagles (USFWS 1986), and the large rivers and wetlands in and adjoining Illinois have served as important winter habitat. Declines in the continental population caused by such factors as habitat destruction, illegal shooting, increasing human use of formerly remote areas, and, more recently, pesticide contamination that resulted in poor reproduction (Evans 1982) have been reflected in the small numbers of eagles observed in Illinois from the late 1800s until about the mid-1900s.

Currently, however, the Mississippi River valley from southern Minnesota to southern Illinois is an important winter area for bald eagles (USFWS 1986). Illinois, Missouri, and Arkansas also host several hundred bald eagles each winter (USFWS 1986). Millsap (1986) analyzed the geographic distribution of wintering bald eagles counted during the 1979 to 1982 midwinter surveys (Fig. 3). Millsap (1986:437) found that over 95% of the bald eagles observed during the midwinter surveys occurred west of a line from Lake Michigan to the Mississippi delta and that more than 30% of the sightings occurred along and adjacent to the Mississippi, Illinois, and Missouri rivers (Fig. 3).

Several major migratory populations of bald eagles have been identified from analysis of band recoveries (Fig. 4) (USFWS 1986). Illinois hosts eagles principally associated with the Western Great Lakes population. The banding analysis revealed that bald eagles that use common winter sites in the Mississippi River valley originate from widely separated breeding areas in Michigan, Wisconsin, Minnesota, and Ontario (Fig. 4).

Statewide Winter Bald Eagle Counts. In the late 1950s, the decline in eagle populations stimulated interest in monitoring the numbers of eagles wintering along the Illinois and Mississippi rivers as an indication of population status. An ongoing program of aerial surveys of migrating waterfowl was begun by the Illinois Natural History Survey (INHS) in 1948 and provided the means to monitor bald eagle populations in the floodplains of the Mississippi and Illinois rivers. In 1957, Frank Bellrose began to count bald eagles in addition to waterfowl on the annual winter inventory conducted in January. This annual count of bald eagles was continued for most years until 1972, when the waterfowl inventory program was expanded to include other areas of Illinois and Robert Crompton made eagle counts a part of each aerial waterfowl census.

In 1961, a second annual winter eagle count was coordinated by Elton Fawks of East Moline. Those counts usually included the entire Upper Mississippi River, but separate data were maintained for the Illinois portion of the river. Additional eagle census information has been compiled by the Illinois Audubon Society as a result of their annual Christmas bird count.

The numbers of eagles sighted on the three winter counts are presented in Table 3. Inventories by the INHS covered the Illinois River from Spring Valley to Naples and the Mississippi River from Rock Island to Grafton (including the lower 26 miles of the Illinois River) for all years listed. The Illinois River from Channahon to Spring Valley was inventoried from 1975 to 1985. The Mississippi River from St. Louis, Missouri, to Cairo was censused from 1973 to 1986 and from Dubuque, Iowa, to Rock Island from 1981 to 1983. Counts were done in these areas as part of the winter waterfowl inventory and were completed between 2 and 18 January each year. Data from these INHS inventories were included in the NWF midwinter bald eagle survey (Table 1).

Total eagles counted by the INHS during January ranged from 63 in 1960 to 1,217 in 1986 (Table 3).

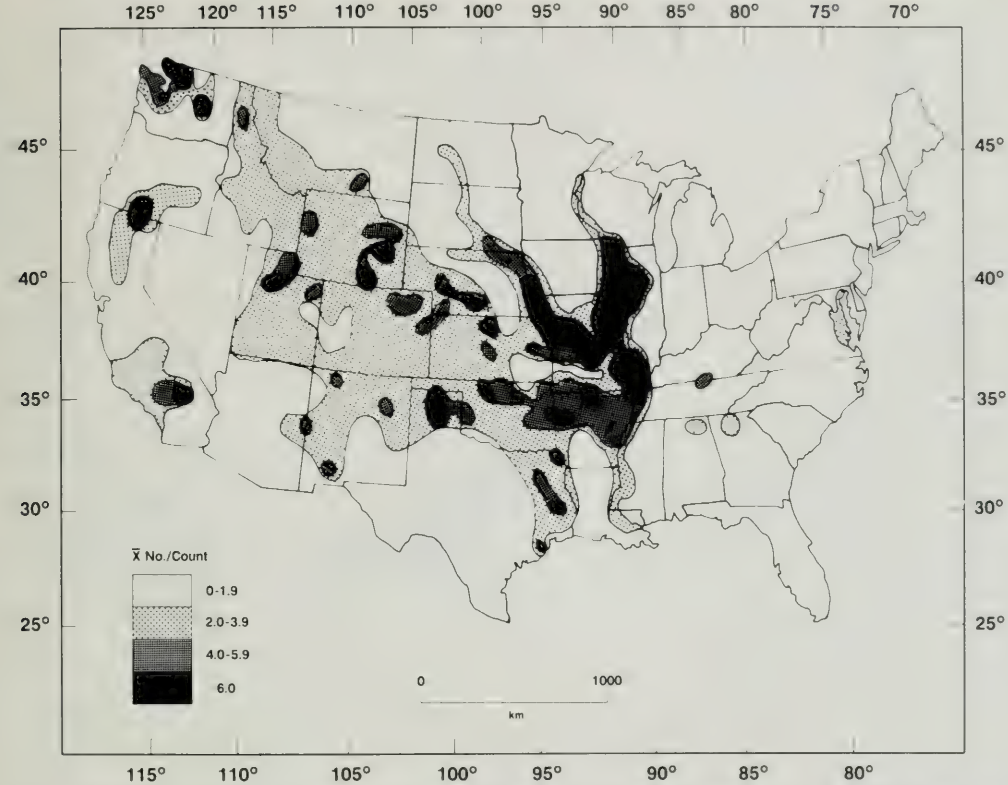

Fig. 3.–Distributions of the average number of bald eagles observed per count during the midwinter surveys, 1979–1982 (Millsap 1986; copyright, The Wildlife Society).

A majority of eagles seen during the winter inventory was associated with the Mississippi River floodplain. Since 1973, numbers of eagles censused in January along the Illinois River usually ranged between 100 and 300, with a maximum of 383 observed in 1986.

The percentage of all eagles censused by the INHS during January that were immatures ranged between 16.5 and 46.5% (Table 3). In a majority of the years, the percentage of immature eagles varied between 30 and 37%. Southern (1963) cautioned, however, against using the proportion of immatures to adult eagles wintering in the Mississippi Valley bordering Illinois as a realistic estimate of reproductive success. Millsap (1986:436) reported that the percentage of immature bald eagles observed on the midwinter survey from 1979 to 1982 varied between 32.7 and 41.2%. Sprunt (1965) reported that estimates of immature bald eagle age ratios ranged between 21.6 and 26.5% from surveys conducted by the National Audubon Society from 1961 to 1963.

The counts compiled by Elton Fawks were both aerial and ground counts (Table 3). Each count included the Mississippi River from Dubuque to "below St. Louis," the Illinois River, and varying numbers and combinations of refuges and reservoirs. The Mississippi River from Grafton to Cairo was added in 1976. The 1982 count also included the Fox, Wabash, Rock, and Ohio rivers. From 1961 to 1978, the count was made during the second or third week of February. Since 1979, when this count became part of the midwinter bald eagle survey sponsored by the NWF, it has been conducted during early to mid-January. Fawks' counts of bald eagles ranged from 414 in 1964 to 1,404 in 1979 (Table 3).

Illinois Audubon Society Christmas bird counts, taken in late December each year, are ground counts made from cars and on foot. These counts probably cover more square miles of the state than the aerial inventories described above, but they do not concentrate on areas near large rivers where bald eagles are

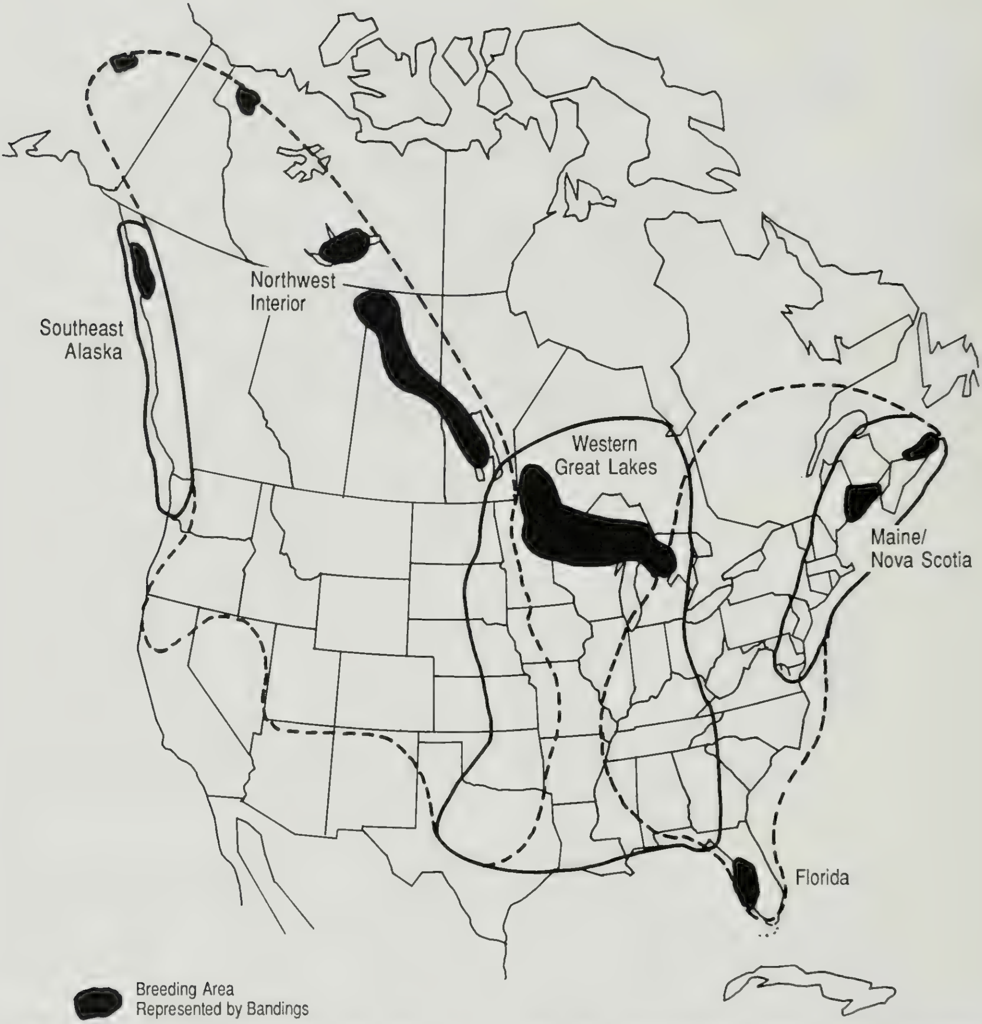

Fig. 4.–Major migratory populations of bald eagles determined from October through March band recoveries (U.S. Fish and Wildlife Service 1986)

most likely to occur. Areas covered in the Christmas bird counts are generally those surrounding the location of local Audubon Society chapters. Bald eagles observed on the Christmas bird counts ranged from 256 in 1974 to 767 in 1986 (Table 3).

Differences in dates of counts, areas covered, skills of observers, and weather conditions and the emphasis placed on counting eagles as opposed to other species create variability among the inventories (Table 3). Whereas counts for a single year vary widely, there are several instances when the changes between years are similar. Examination of eagle numbers in Table 3 reveals that both the INHS and Fawks inventories show increases from 1961 to 1962, decreases from 1962 through 1964, and increases from 1964 to 1965 and from 1977 through 1979. Such similarities in trends suggest that patterns of changes in eagle numbers in Illinois are real and demonstrate the importance of more than one type of annual count.

Moving 3-year averages of the annual winter

Table 3.—Winter bald eagle counts conducted by the Illinois Natural History Survey, Elton Fawks, and the Audubon Christmas bird count, 1957–1987.

	INHS			Fawks[a]				Audubon[b,c]			
Year	Adult	Immature	Total	Adult	Immature	Unaged	Total	Adult	Immature	Unaged	Total
1957			359								
1959			207								
1960			63								
1961	142	30	172	365	51	1	417				
1962	143	44	187	417	62	29	508				
1963	108	64	172	331	91	7	429				
1964	68	30	98	226	58	130	414				
1965	75	52	127[d]	420	160	44	624				
1966				486	122	51	659				
1967				485	175	28	688				
1968	84	37	121[d]	415	174	50	639				
1969				391	261	3	655				
1970	112	76	188								
1971	100	40	140	406	159	11	576				
1972	75	19	94	562	302	31	895	158	95	29	282
1973	364	175	539	529	231	14	774	211	115	14	340
1974	398	153	551	413	128	8	549	140	113	3	256
1975	365	201	566	519	274	32	825	304	182	110	596
1976	489	270	759	459	214	33	706	287	269	6	562
1977	327	144	471	508	264	29	801	405	252	11	668
1978	369	166	535	696	219	52	967	503	247	11	761
1979	410	203	613	1,018	356	30	1,404	244	149	10	403
1980	514	288	802	931	406	57	1,394	384	203	7	594
1981	454	304	758					228	153	5	386
1982	517	271	788	888	380	28	1,296	211	128	3	342
1983	365	178	543					292	256	17	565
1984	613	317	930					316	218	3	537
1985	404	247	651					420	235	12	667
1986	779	438	1,217					443	313	11	767
1987	368	201	569								

[a] Fawks (1983).
[b] Struthers (1973, 1974, 1975, 1976, 1977, 1978, 1979, 1980).
[c] Stroyls (1981, 1982, 1983, 1984, 1985, 1986, 1987).
[d] Incomplete count.

counts are presented in Figure 5. Each of the three inventories shows a general trend toward higher numbers in recent years. As noted by Fawks (1983), weather and other factors that interfere with accurate counts are of lesser importance if data interpretation is based on multi-year averages rather than one-year totals. Counts by the Illinois Audubon Society were probably also influenced by changes in geographical coverage between years.

INHS Eagle Surveys. The most extensive record of bald eagle populations in Illinois was compiled by the INHS. Eagles were counted once each year in 1957, 1959 to 1965, 1968, 1970, and 1971 (Table 3). Since 1972, several counts were made each year in 11 regions of the state (Table 4, Fig. 6) and provide detailed information. Riverine regions inventoried included the river proper and accompanying wetlands in the floodplain. Censuses conducted in the Mississippi River floodplain included eagles seen in Iowa and Missouri. Each region was divided into a number of census areas for recording data. Individual areas included river segments defined by prominent landmarks, lakes, bays, marshes, sloughs, or other wetland areas. The census areas included in each region are listed in the Appendix. The number of miles of river and the area of wetlands in each riverine region are presented in Table 5.

The number of years in which aerial censuses were taken in a region and the number of flights made each year were dependent upon availability of funds

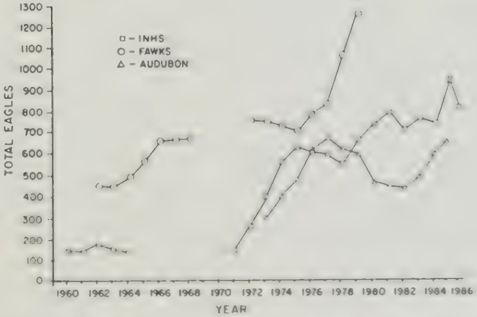

Fig. 5.—Three-year moving averages of winter eagle counts in Illinois from Illinois Natural History Survey data, Fawks (1983), and the Illinois Audubon Society (Struthers 1973, 1974, 1975, 1976, 1977, 1978, 1979, 1980; Stroyls 1981, 1982, 1983, 1984, 1985 1986, 1987)

Table 4.—Regions aerially inventoried for bald eagles by the INHS and the frequency, approximate period, and years of censuses in each region.

Region	Frequency of Inventories	Approximate Inventory Period[a]	Year
Upper Mississippi River (Dubuque–Interstate 80)	Biweekly	October–March	1980–1983
Upper Central Mississippi River (Moline–Keokuk)	Weekly	Sept.–Dec., Jan., Feb.–April	1972–1986
Lower Central Mississippi River (Keokuk–Alton, lower 26 miles of Illinois River)	Weekly	Sept.–Dec., Jan., Feb.–April	1972–1986
Lower Mississippi River (St. Louis–Cairo)	Biweekly	October–April	1972–1986
Upper Illinois River (Morris–Spring Valley)	Biweekly	September–April	1976–1985
Central Illinois River (Spring Valley–Lower Peoria Lake)	Weekly	Sept.–Dec., Jan., Feb.–April	1972–1986
Lower Illinois River (Pekin Lake–Naples)	Weekly	Sept.–Dec., Jan., Feb.–April	1972–1986
Surface-mined Lakes (Fulton, Knox counties)	Biweekly	October–March	1980–1985
Northeast Lakes (natural lakes, cooling lakes, reservoirs in Cook, De Kalb, Grundy, Lake, La Salle, McHenry, Will counties)	Biweekly	September–April	1976–1985
Central and Southern Lakes (Reservoirs: Carlyle, Rend, Shelbyville, Springfield. Cooling lakes: Baldwin, Clinton, Coffeen, Newton, Sangchris)	Biweekly	October–April	1972–1986
Lower Kaskaskia River (Fayetteville–Chester)	Biweekly	October–April	1982–1986

[a] Period lengths varied due to availability of flight funds.

and on weather (Table 4). The number of aerial inventories, mean number of bald eagles observed per inventory, and maximum number of eagles seen on a single inventory for each census area for all census years are presented in the Appendix. The mean number of bald eagles sighted per inventory flight for all years was used as the indicator level of eagle use for a given area. The number of inventories and the mean number of eagles observed per inventory were based on the period between the first sighting of a bald eagle in the fall of each year and the last eagle sighting the following spring, and not the entire census period from fall through spring. This procedure appropriately concentrated on the period when eagles were present in the various regions. The arrival and departure dates of bald eagles in Illinois vary each year as a result of differences in weather, freeze-ups, and other unpredictable phenomena of nature.

Differences in the length of the inventory period and the number of years of censuses should be taken into consideration when making comparisons in values for the mean number of eagles counted per inventory among regions (Table 4). For instance, the Upper Mississippi River Region was inventoried during 1980–1983 as compared with 1972–1986 for the other Mississippi River regions. Bald eagles have generally increased in Illinois since 1972 (Table 3) and a mean value for the number seen per inventory in more recent years (1980–1983) may provide a different value than a mean calculated on data from 1972–

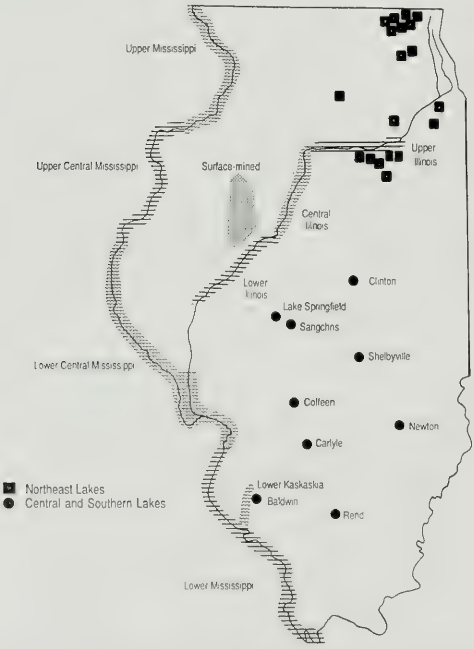

Fig. 6.—Regions of Illinois inventoried for bald eagles by the Illinois Natural History Survey, 1972–1987

Table 5.—River miles and wetland area included in riverine census regions.

Region	River Miles[a]	Wetland Area[b]	
		mi^2	km^2
Upper Mississippi River	85.4	122.9	318.3
Upper Central Mississippi River	131.3	168.5	436.4
Lower Central Mississippi River	187.1	265.3	687.1
Lower Mississippi River	202.9	242.2	627.3
Upper Illinois River	57.0	24.6	63.7
Central Illinois River	57.8	82.4	213.4
Lower Illinois River	136.2	154.6	400.4
Lower Kaskaskia River	30.0	22.5	58.3

[a] U.S. Army Corps of Engineers (1978), Illinois Division of Waterways (1969).

[b] Hagen et al. (1977), Havera (1985).

1986. However, the mean number of eagles seen per inventory was the most logical method of presenting the data.

Upper Mississippi River Region. The Upper Mississippi River Region extends from the Illinois-Wisconsin border southward to approximately Rock Island, Illinois (Fig. 6). This region was surveyed from October through March during the three winters of 1980–1983 and substantial numbers of eagles were counted. The floodplain in this area provided attractive winter habitat for bald eagles (Fig. 7).

Fig. 7.–Typical riverine habitat of the Upper Mississippi River Region.

The seasonal pattern of eagle use of the Upper Mississippi River Region is shown in Figure 8. Annual peak population counts occurred between 2 February and 23 March. Substantial numbers of birds were still present when counts were terminated each spring. The greatest 1-day count was 213 eagles on 23 March 1983. Southern (1964) observed peak numbers of 268 and 225 eagles in this region on 2 February 1962 and on 5 February 1963, respectively. A total of 2,663 eagle sightings was recorded in this region; 34.9% of those were immatures. The proportion of immature birds ranged from 30.9 to 41.6% on individual census flights.

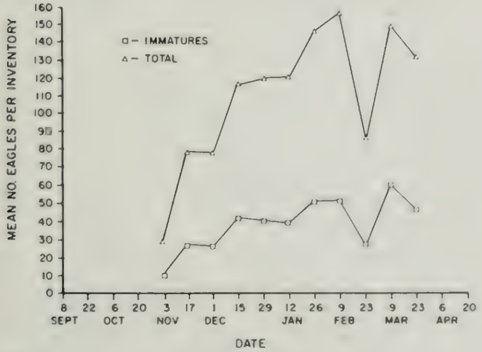

Fig. 8.–Mean number of bald eagles counted per inventory in the Upper Mississipi River Region, 1980–1983.

The mean count per inventory on individual census areas is shown in Figure 9. The area between the Wapsipinicon River and Princeton was the most heavily used in this region, with an average of 20.9 eagles sighted per inventory (Appendix). Other heavily used areas were the Bellevue to Green Island segment and the Fulton to Albany area. The Upper Mississippi River Region also includes the Oak Valley Eagle Refuge in Rock Island County. The heavy use of this area by wintering bald eagles was documented by Elton Fawks through 25 years of observation and because of its importance, the refuge was purchased by the Illinois Department of Conservation (IDOC) in 1980.

For the Upper Mississippi River Region as a whole, bald eagles occurred at an average density of 1.38 eagles per river mile or 0.96 eagle per square mile of wetland habitat from 1980–1983. These values are higher than those for any other region of the Mississippi and Illinois rivers; however, the Upper Mississippi River Region has been flown for fewer years than the other regions (Table 4, Fig. 6).

Upper Central Mississippi River Region. The Upper Central Mississippi River Region stretches from approximately Rock Island, Illinois, to Keokuk, Iowa (Fig. 6). Between 1972 and 1986, most areas within this region were surveyed from 120 to 130 times. Flights were made from September through December in 1972 to 1985, during January from 1973 to 1986, and from February through April from 1980 to 1985.

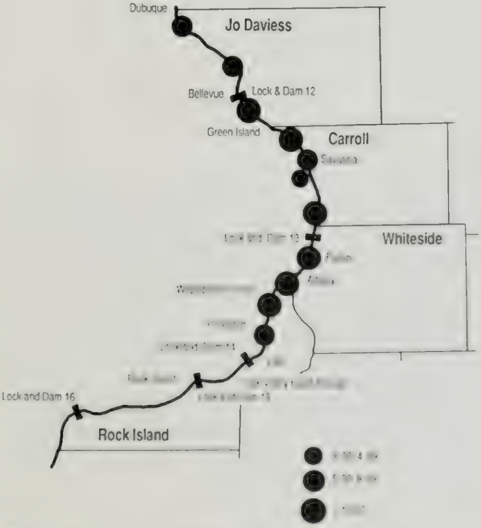

Fig. 9.–Mean number of bald eagles counted per inventory at census areas within the Upper Mississippi River Region, 1980–1983.

The level of eagle use in the Upper Central Mississippi River Region from fall through spring is shown in Figure 10. Few inventories were conducted during late January and early February. In each year except 1983, at least one inventory was conducted in the fall before any eagles were observed and those flights allowed an approximation of the arrival date of bald eagles in this region. Estimates of arrival dates of eagles observed from the air for 11 autumns indicated that arrival gradually became earlier. From 1972 to 1975 the first eagle sightings were in late November, but from 1976 to 1981 the first observations usually occurred in late October or early November. In 1982 and 1983 eagles were present in the Upper Central Mississippi River Region by late September. Spring data indicated that all eagles usually left this region by early April.

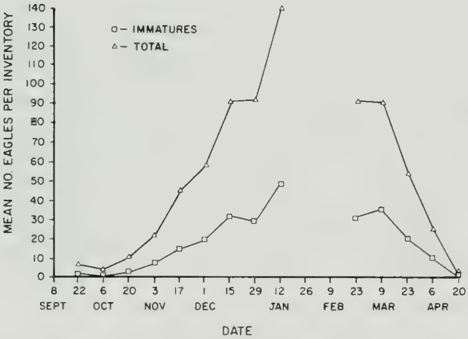

Fig. 10.–Mean number of bald eagles counted per inventory in the Upper Central Mississippi River Region, 1972–1986.

Peak population counts occurred each year between 11 December and 7 March. The largest number of eagles seen on a single day was 180 on 5 January 1984 and again on 2 December 1985. Immature birds ranged between 0 and 48.3% of the eagles seen on individual flights whereas the overall proportion of immatures censused in this region was 34.7%.

Mean counts per inventory on individual areas are shown in Figure 11. Eagles are found throughout this region, but the areas between Ft. Madison, Iowa, and Keokuk, Iowa, generally hosted the most birds (Fig. 11, Appendix). The average density of bald eagles in the Upper Central Mississippi River Region was 0.46 bird per river mile or 0.36 per square mile of wetland habitat.

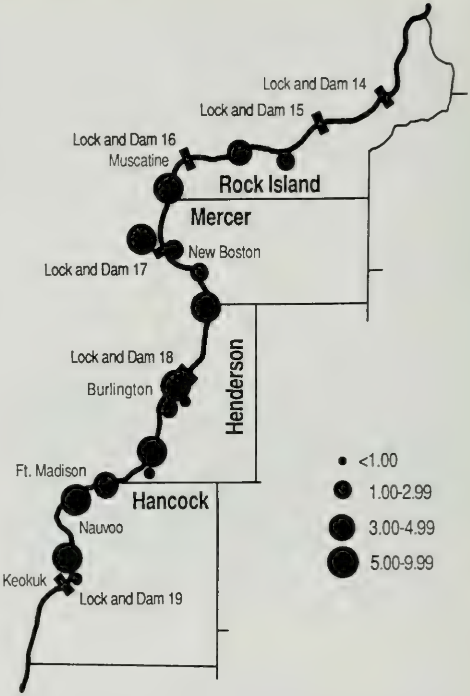

Fig. 11.–Mean number of bald eagles counted per inventory at census areas within the Upper Central Mississippi River Region, 1972–1986.

Lower Central Mississippi River Region. The Lower Central Mississippi River Region extends from Keokuk, Iowa, southward to Grafton, Illinois, and includes the lower 26 miles of the Illinois River (Fig. 6). This region also was censused from 120 to 130 times between 1972 and 1986. Census flights were made during September through December from 1972 to 1985, during January from 1973 to 1986, and during February through April from 1980 to 1985.

Seasonal trends in eagle numbers in the Lower Central Mississippi River Region are shown in Figure

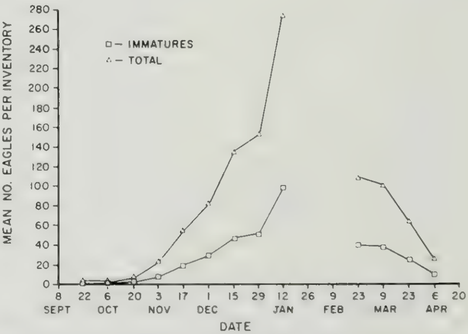

Fig. 12.–Mean number of bald eagles counted per inventory in the Lower Central Mississippi River Region, 1972–1986.

12. Fall arrival and spring departure dates were similar to those observed in the Upper Central Mississippi River Region. The progression to earlier arrival of eagles observed on aerial inventories during fall in recent years also occurred in this region.

The highest counts for each year occurred between 11 December and 8 March and the largest number of bald eagles recorded in this region was 527 on 6 January 1986. Immature eagles accounted for 0 to 66.7% of the birds seen on individual flights and an overall average of 35.6% of the eagles sighted in this region were immatures.

Figure 13 depicts the mean number of eagles per inventory counted on individual areas. The largest gatherings of bald eagles within this region occurred at Flat and Swan lakes near the confluence of the Illinois and Mississippi rivers (Fig. 14) and between the towns of Keokuk and Meyer (Fig. 13) on the Mississippi River. The vicinity of Flat and Swan lakes often held more eagles than any other census area in this region (Appendix). Of 127 flights conducted at Flat and Swan lakes, there were only 15 on which no eagles were seen. The highest number of eagles counted at Flat and Swan lakes was 269 (146 adults, 123 immatures) on 6 January 1986, and this was 51.0% of the birds seen in the entire Lower Central Mississippi River Region on that date.

The Keokuk vicinity (Fig. 15) hosts what may be the largest concentration of wintering bald eagles found anywhere on the entire Mississippi River. Large numbers of eagles are attracted to the area near Lock and Dam 19 at Keokuk in winter because of the open water below the dam and the readily available supply of fish killed or injured as they pass through turbines of the hydroelectric plant associated with the dam. The main item in the diet of bald eagles wintering in Illinois is fish (Southern 1963, 1964, 1966, Jonen 1973, Fischer 1982, Harper 1983, Sabine & Klimstra 1985). Each January, IDOC hosts the popular Bald Eagle Appreciation Days in this area for the public to view the large numbers of wintering eagles. In this area, IDOC, The Nature Conservancy, and Western Illinois University manage properties (Fig. 15) that are maintained for foraging and night roosting of bald eagles. The numbers of bald eagles in the Keokuk area are undoubtedly higher than the INHS aerial census data reflect because not all of the managed properties are censused and because few flights are made during January and February when bald eagle numbers are usually at their zenith.

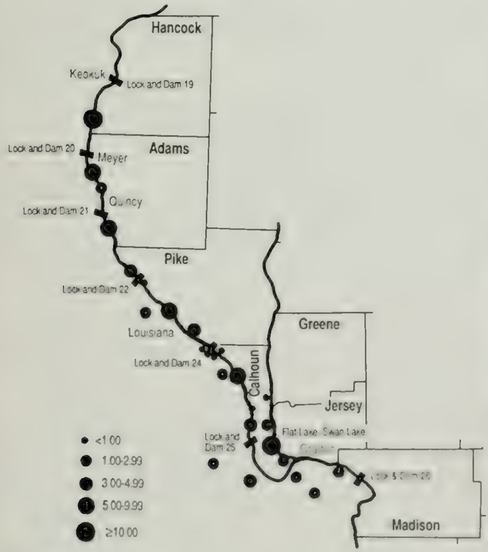

Fig. 13.–Mean number of bald eagles counted per inventory at census areas within the Lower Central Mississippi River Region, 1972–1986.

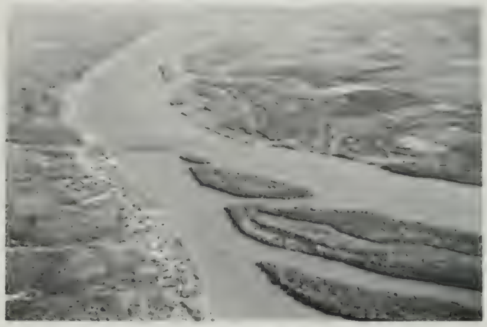

Fig. 14.–Southward view of the confluence of the Illinois and Mississippi rivers, an important area for wintering bald eagles.

Fig. 15.–Northwestward view of the Cedar Glen Eagle Roost in Hancock County, Illinois, and the floodplain below Lock and Dam 19 at Keokuk, Iowa. This area typically hosts the largest number of wintering bald eagles in the Mississippi River valley (Photo by John Warnock)

The average density of bald eagles in the Lower Central Mississippi River Region for all inventories was 0.48 per river mile or 0.34 per square mile of wetlands. These values are similar to those for the Upper Central Mississippi River Region.

Lower Mississippi River Region. The Lower Mississippi River Region extends from approximately St. Louis, Missouri, southward to Cairo, Illinois (Fig. 6). Most areas in this region were inventoried between 105 and 110 times since 1972. Censuses were made during October through April from 1972 to 1985 and in January 1986.

The seasonal variation in eagle numbers in the Lower Mississippi River Region is shown in Figure 16. The first eagle sightings in this region usually occurred from late October to mid-November, somewhat later than in the more northern reaches of the Mississippi River. Spring departures, however, were usually similar in most years to those in other regions of the Mississippi River, although from 1983 to 1985 eagles were present until late April, or 2 to 3 weeks later than in other regions.

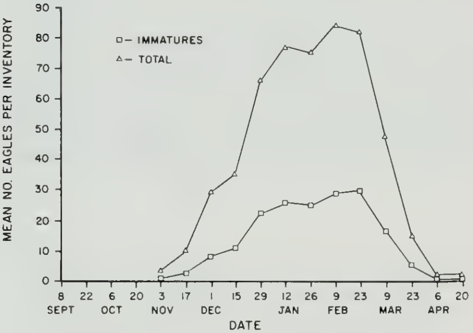

Fig. 16.—Mean number of bald eagles counted per inventory in the Lower Mississippi River Region, 1972–1986.

Peak population counts occurred between 4 January and 18 February in this region. The highest number of bald eagles observed on one day was 262 on 6 February 1979. Immature birds ranged between 0 and 100% of the eagles seen on individual inventories and averaged 33.6% for all inventories.

The mean number of eagles per inventory for areas within this region is shown in Figure 17. Numbers of bald eagles were higher in the downstream portion of this reach (Appendix). Few eagles were seen between St. Louis and Kimmswick, Missouri, but numbers steadily increased to the area from Cape Girardeau, Missouri, to Cairo, Illinois, where the highest numbers were seen. This stretch of the river is also adjacent to some of the major winter areas for Canada geese (*Branta canadensis*) in southern Illinois.

The average density of bald eagles in the Lower Mississippi River Region was 0.24 bird per river mile or 0.20 per square mile of wetland habitat. These density values of bald eagles were the lowest of all the Mississippi River regions.

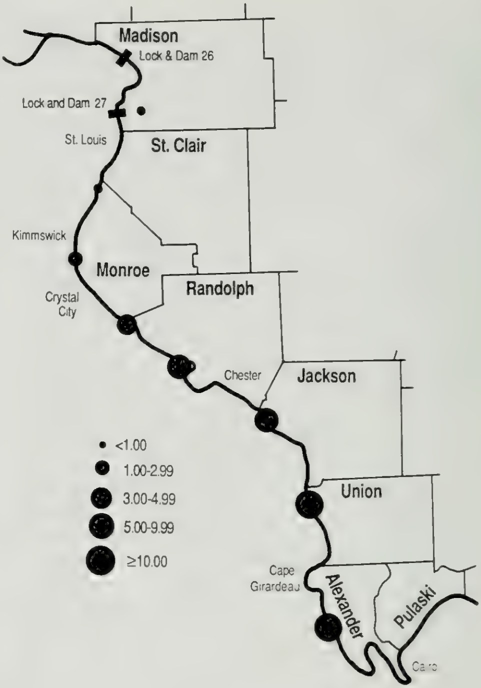

Fig. 17.—Mean number of bald eagles counted per inventory at census areas within the Lower Mississippi River Region, 1972–1986.

Upper Illinois River Region. The Upper Illinois River Region stretches from Morris, Illinois, to near Spring Valley, Illinois (Fig. 6). Most portions of this region were surveyed 59 times between September and April from 1976 to 1985. This relatively short, highly developed segment of the Illinois River valley seldom showed substantial use by bald eagles.

The seasonal pattern of eagle numbers in the Upper Illinois River Region is shown in Figure 18. The trend toward earlier observations of eagles in the fall during the years inventoried was also apparent in this region. In the late 1970s, eagles were usually first seen during aerial inventories in the latter half of November, but in more recent years, the first observations generally occurred in mid-October. The earliest sighting of bald eagles during any census in all regions (Fig. 6) occurred in the Upper Illinois River Region when four birds were seen between Utica and Marseilles on 10 September 1980. Spring departure of eagles from the Upper Illinois River Region was generally completed by early April.

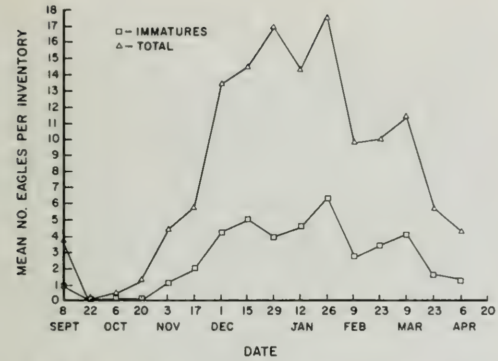

Fig. 18.–Mean number of bald eagles counted per inventory in the Upper Illinois River Region, 1976–1985.

Peak population counts occurred between 3 January and 9 March in this region with the highest count of 53 eagles reported on 20 January 1982. Generally, fewer than 25 eagles were seen on each census in this region. Immature birds consisted of 0 to 50.0% of the eagles observed on individual inventories, and the average proportion of immatures for all eagles seen was 31.8%.

The mean number of bald eagles observed per inventory for individual areas is depicted in Figure 19. The downstream portion of this region, between La Salle, Illinois, and Spring Valley, Illinois, was generally used the most by eagles (Appendix). The density of bald eagles in the Upper Illinois River Region averaged 0.20 per river mile or 0.47 per square mile of wetlands.

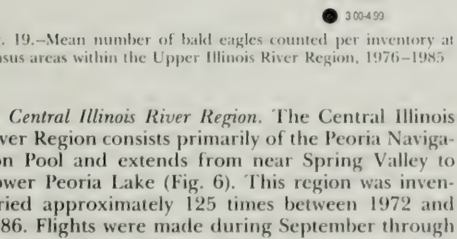

Fig. 19.–Mean number of bald eagles counted per inventory at census areas within the Upper Illinois River Region, 1976–1985

Central Illinois River Region. The Central Illinois River Region consists primarily of the Peoria Navigation Pool and extends from near Spring Valley to Lower Peoria Lake (Fig. 6). This region was inventoried approximately 125 times between 1972 and 1986. Flights were made during September through December from 1972 to 1985, during January from 1973 to 1986, and during February through April from 1980 to 1985.

Seasonal patterns of bald eagle occurrence in the Central Illinois River Region are illustrated in Figure 20. No census flights were conducted from mid-January to late February. The trend towards earlier observations during aerial inventories of eagles in the fall was also apparent in this region. Since 1981, birds were generally present by late September. As in many other parts of Illinois, all eagles had departed by early April.

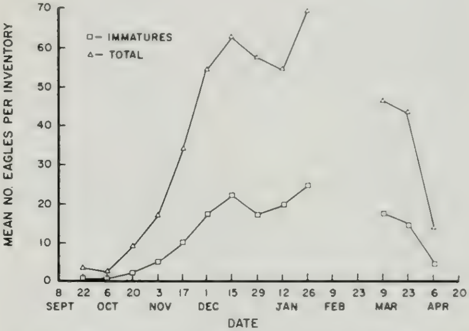

Fig. 20.–Mean number of bald eagles counted per inventory in the Central Illinois River Region, 1972–1986.

Eagle populations in this region peaked between 2 December and 21 March. The largest number seen on one inventory was 170 on 19 March 1980, but since then the highest number of eagles seen on a single day was 104. The proportion of immatures ranged from 0 to 54.8% of all eagles seen on individual counts and the overall mean for immatures was 33.1% for all censuses.

The mean number of eagles counted per inventory for individual areas is shown in Figure 21. Some of the areas in this region with high use by bald eagles included Hitchcock Slough (Marshall County), Rice Pond across from Chillicothe, Upper Peoria Lake, and Goose and Senachwine lakes (Fig. 22) in Bureau and Putnam counties (Appendix). The density of bald eagles observed in the Central Illinois River Region averaged 0.67 eagle per river mile or 0.47 per square mile of wetland habitat.

Lower Illinois River Region. The Lower Illinois River Region consists primarily of the La Grange Pool of the Illinois River and stretches from Pekin to Naples (Fig. 6). This region has been more closely monitored for eagles than any other with over 130 inventories taken from 1972 to 1986. Census flights were made during September through December from 1972 to 1985, during January from 1973 to 1986, and during February through April from 1980 to 1985

Seasonal variation in eagle use of this region is shown in Figure 23. No census flights were conducted from mid-January to late February. Times of fall arriv

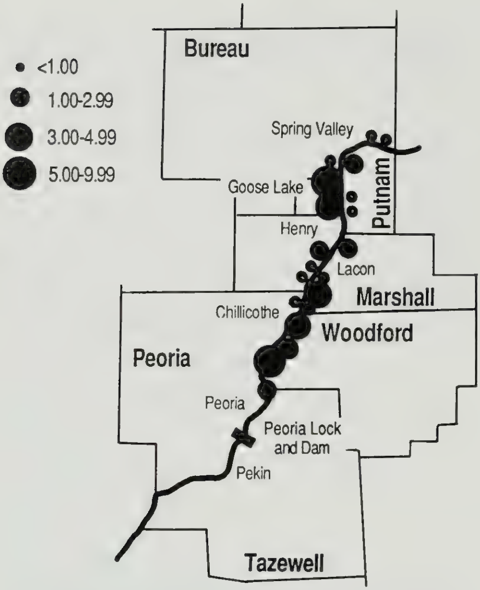

Fig. 21.–Mean number of bald eagles counted per inventory at census areas within the Central Illinois River Region, 1972–1986.

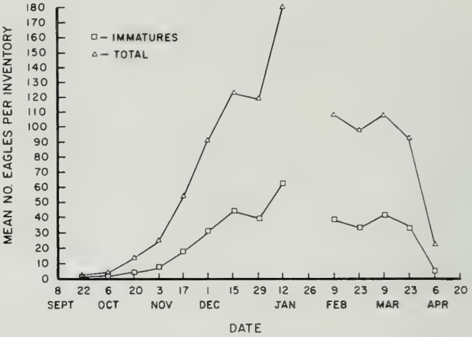

Fig. 23.–Mean number of bald eagles counted per inventory in the Lower Illinois River Region, 1972–1986.

al in late September and early October and spring departure by early April were similar to those in the Central Illinois River Region. Eagles arrived in the Lower Illinois River Region approximately 1 week earlier than in the Central Illinois River Region in 2 of the 15 years inventoried.

Peak population counts have occurred from 2 December until 18 March; the latter is also the date of the highest 1-day count of 345. The proportion of immatures seen on individual censuses ranged from 0 to 50.0% of the total eagles observed, and the overall proportion of immatures was 34.7% for all inventories.

Fig. 22.–Eastern shore of Goose Lake, Bureau County, looking into Senachwine Lake.

The mean number of eagles inventoried per census flight is illustrated in Figure 24. Areas with the most use by bald eagles included Chautauqua National Wildlife Refuge (Fig. 25), Crane Lake, Clear Lake, Cuba Island, and Jack Lake (Appendix). All of these areas are privately owned except the 4,500-acre (1,822-ha) Chautauqua Refuge.

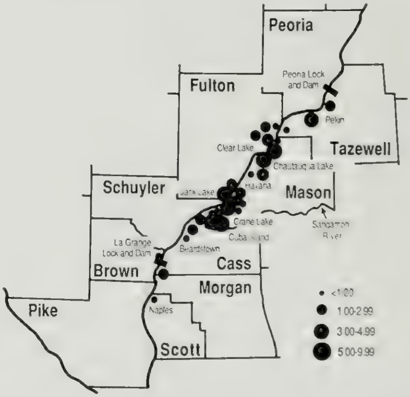

Fig. 24.–Mean number of bald eagles counted per inventory at census areas within the Lower Illinois River Region, 1972–1986.

The estimated density of bald eagles in the Lower Illinois River Region averaged 0.56 per river mile or 0.49 per square mile of wetland habitat. The average density per square mile of wetlands (0.49) in this region was slightly higher than the value for the Central and Upper Illinois River regions (0.47) and was also higher than the values for all of the Mississippi River

Fig. 25.–Northeastward view of the Chautauqua Lake area, an important winter site for bald eagles in the Lower Illinois River Region.

regions (0.20–0.36), with the exception of the Upper Mississippi River Region (0.96). The average density of eagles per river mile (0.56) in the Lower Illinois River Region was slightly lower than the value for the Central Illinois River Region (0.67), higher than those values for the Upper Illinois (0.20), Lower Mississippi (0.24), and the Upper and Lower Central Mississippi regions (0.46 and 0.48, respectively), but substantially lower than the value (1.38) for the Upper Mississippi River Region.

Central and Southern Lakes Region. A vast majority of bald eagles wintering in Illinois was found in the floodplains of the Illinois and Mississippi rivers (Figs. 6 and 26). Relatively small numbers of eagles were counted in other regions. Of the nine reservoirs and cooling lakes censused in central and southern Illinois (Fig. 6, Appendix), five (Sangchris, Carlyle, Rend, Baldwin, and Springfield) were inventoried on a regular basis from October through April since 1972. However, only Carlyle and Rend lakes averaged more than one eagle per census (Fig. 26, Appendix). No eagles were sighted at Clinton Lake. Eagle use of these lakes in central and southern Illinois declined in recent years.

Northeast Lakes Region. The natural lakes, reservoirs, and cooling lakes in counties of northeastern Illinois (Fig. 6, Appendix) also hosted few eagles. These lakes were censused from September through April since 1976. The McHenry Dam area in McHenry County was the only area that held an average of more than one eagle per census (Fig. 26, Appendix). Eagle numbers were slightly higher in the late 1970s in this region, but fell to near zero in later years.

Surface-mined Lakes Region. Inventories of surface-mined lakes in Fulton and Knox counties in west-central Illinois (Fig. 6) revealed limited use by bald eagles (Fig. 26). Inventories were conducted from October through March from 1980 to 1985. No eagles were sighted on most of the lakes in this region but small numbers were seen on a regular basis on the Central Illinois Light Company (CILCO) property (Appendix).

Lower Kaskaskia River Region. The Lower Kaskaskia River Region (Fig. 6) included the lower 30 miles of the river from approximately Fayetteville to Chester on the Mississippi. This region was surveyed during October to April from 1982 to 1986 (Fig. 26). From 1982 to 1985 bald eagle use in this region was low with never more than one eagle sighted on a census; however, on 7 January 1986, nine eagles were observed (Appendix).

Other Inventories. Other studies that monitored bald eagle populations over one or two winters in small geographic areas have been conducted in Illinois. Such studies, because of the frequency of counts and the limited area involved, provided information on the abundance and use patterns of bald eagles that is not obtainable from periodic regional counts.

Southern (1963) monitored eagle populations near the Savanna Army Depot in Jo Daviess County in the

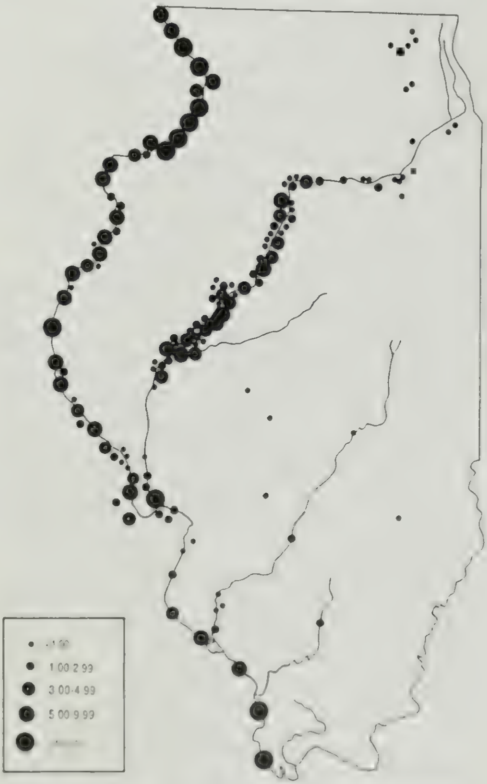

Fig. 26.–Mean number of bald eagles counted per inventory at census areas within all regions, 1972–1986.

Upper Mississippi River Region (Figs. 8 and 9) during the winter of 1961–1962. He reported that eagles were present in that area from before 9 December until 1 April. The peak population count occurred in this area on 2 February when 262 birds were counted along a 14-mile census route.

A second study by Southern (1964) was done in the same area during the winter of 1962–1963. Counts were initiated earlier in the fall and the first eagles were sighted on 21 October. After a peak of 225 birds on 5 February, all eagles had left the area by 9 April. Through most of the winter, only about 10 to 12% of the bald eagle population in this area were immature birds.

Jonen (1973) studied bald eagles on a 6-mile reach of the Mississippi River extending downstream from Lock and Dam 19 at Keokuk (Figs. 12 and 13). In the winter of 1970–1971 he first noticed an immature bald eagle in this area on 3 October. The first adult eagle was sighted on 13 December and the peak population count for that winter was 49 (40 adults, 9 immatures) on 8 January. Jonen sighted the first eagle, an immature, during the 1971–1972 season on 18 October. An adult eagle was first sighted on 29 November, and the largest number of eagles sighted was 66 (57 adults, 9 immatures) on 12 February.

Two patterns noticed by Jonen (1973) were that immature eagles were present in the area earlier in the fall and later in the spring than adults and that the number of eagles present in his study area increased during periods of extremely cold weather.

Fischer (1982) studied the same area described by Jonen (1973) and found that bald eagle use of this area had increased dramatically in the 7 years since Jonen's work. During the winter of 1978–1979, which was a winter of record-breaking low temperatures and heavy snowfall, Fischer (1982) monitored eagle numbers from early December to early April. A peak count of 454 eagles (359 adults, 88 immatures, 7 not aged) occurred on 18 January 1979. The count far exceeded any recorded previously in the vicinity of Lock and Dam 19 and was not equaled in the following 6 years.

Fischer (1982) also made inventories from late November 1979 until the end of March 1980. During a relatively mild winter, the peak number of eagles counted was 120 (89 adults, 31 immatures) on 18 February 1980. The peak for 1979–1980 was only 26.4% of the peak count for the previous winter.

Harper (1983) studied eagle populations in the vicinity of Lock and Dam 24 at Clarksville, Missouri, in the Lower Central Mississippi River Region (Figs. 6 and 13). He conducted aerial and ground surveys in 1980–1981 and ground counts in both foraging and night roosts during the winter of 1981–1982. Aerial counts conducted in 1980–1981 gave consistently lower counts than ground counts done simultaneously. Daytime ground counts usually provided lower totals than counts done on the same date at night roosts. The highest count recorded during this study was 168 eagles (92 adults, 57 immatures, 19 unaged) observed at a night roost on 26 January 1982.

Sabine and Klimstra (1985) inventoried bald eagles in southern Illinois at Union County and Horseshoe Lake Conservation areas during 1979–1981 and at Crab Orchard National Wildlife Refuge (CONWR) during 1980–1981. Eagles are probably attracted to these areas by the large numbers of wintering Canada geese because crippled and dead geese provide a readily available source of food for wintering eagles. Eagles arrived in these areas in late October and departed by early March. Peak population counts for eagles in 1979–1980 were 71 at Union County on 19 February and 78 at Horseshoe Lake on 8 February. During 1980–1981, peak populations of eagles occurred on 23 January when there were 79 at Union County and 77 at Horseshoe Lake. Approximately 76% and 65% of the peak populations of eagles were immatures at Union County and Horseshoe Lake, respectively. These values for immatures are much higher than those noted for areas along the Illinois and Mississippi rivers (Jonen 1973, Fischer 1982, Havera et al. 1984). CONWR was used by relatively few eagles as shown by a peak count of only 29 in mid-December 1980.

Southern et al. (1985) conducted 12 statewide aerial surveys of bald eagles during the winter of 1984–1985. This was the first attempt at 1-day statewide censuses. All previous studies included 1-day counts in relatively small areas (Jonen 1973, Sabine 1981) or counts over large areas that were completed in a period of days (INHS aerial surveys).

In addition to documenting changes in bald eagle populations in Illinois, which peaked at 989 on 8 February 1985, Southern et al. (1985) identified 13 essential areas of winter habitat using criteria suggested by Grier et al. (1983). These included any area of 15 mi (24 km) or less in length along a river that was used by 15 or more bald eagles for 2 weeks or longer. Southern et al. (1985) found that the most heavily used winter area was that portion of the Mississippi River near Lock and Dam 19 at Keokuk. In the Illinois River valley, the area used most by bald eagles was Pere Marquette State Park in Jersey County. All areas found to be essential winter habitat by Southern et al. (1985) are shown in Figure 27.

Small concentrations of bald eagles sometimes occur away from the floodplains of major rivers. For example, between 20 and 25 bald eagles were seen frequenting a wooded area of Pike County during the 1986–1987 winter. These eagles were feeding on livestock carcasses and were roosting close to the food source and not in the Illinois or Mississippi river floodplains.

DISCUSSION OF CENSUS DATA

Although a concentrated effort has been made to monitor the numbers of bald eagles wintering in Il-

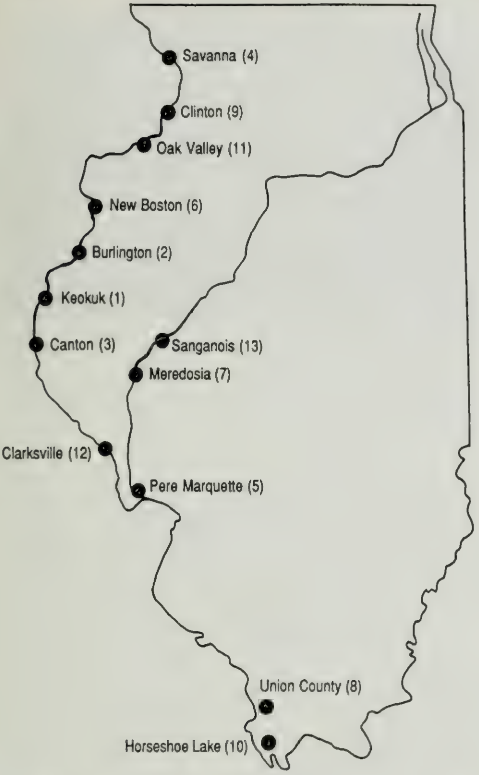

Fig. 27.–Locations of essential bald eagle winter habitat identified by Southern et al. 1985. Numbers indicate importance ranking.

linois, bald eagle census data for Illinois should be considered an estimate or index of actual populations.

For a variety of identified and undetermined reasons, counts of bald eagles made on a specific area are subject to extreme short-term variations. This variation is well demonstrated by data from Fischer (1982). In his study, two or three ground counts often were made on the same day, and those counts differed by as much as 35% or 150 eagles. However, variations in the numbers of eagles seen were not consistent. Numbers of eagles sometimes increased or decreased during the same day. The lack of simultaneous counts over a wide area and the mobility of bald eagles make it difficult to determine whether daily fluctuations in numbers were caused by local movements or by shifts in populations over larger geographic areas.

Dunstan and Fawks (1981) stated that food availability is the primary reason for the southward movement of bald eagles into Illinois during winter. Keister et al. (1987) reported that the interaction of food availability and proximity of roosting habitat appeared to be a primary factor in the behavior of wintering bald eagles. Structures such as locks and dams or activities that maintain open water in winter and, therefore, the availability of fish serve as an attractant to bald eagles, particularly if suitable daytime perches and night roost areas are nearby. As noted by Steenhof (1978), the abundance and distribution of wintering bald eagles have been greatly affected by construction of dams and impoundments. Fischer (1982) found that the extent of ice cover on the Mississippi River influenced the local distribution of eagles. As the area of open water changed, the eagles shifted their patterns of use to take advantage of available forage. Harper (1983) reported similar shifts in bald eagle use patterns near Lock and Dam 24.

Jonen (1973) and Fischer (1982) reported a correlation between extremely cold temperatures and increasing numbers of bald eagles present on the Lock and Dam 19 study area. An increase in eagle numbers generally occurred a few days after the onset of a cold period. However, there was no apparent relationship between population changes of eagles and low temperatures over the large geographic areas surveyed aerially by INHS, a finding which suggests that the relationship between movement and temperature noted by Jonen (1973) and Fischer (1982) could be a local phenomenon. Millsap (1986) found that bald eagles appeared to winter farther south during unusually cold winters.

Southern (1963, 1964) and others suggested that immature bald eagles move south earlier and move farther south than adults. Millsap (1986) found that the percentage of immature bald eagles in the midwinter survey increased at southern latitudes. Both Jonen (1973) and Fischer (1982) reported sighting a higher proportion of immatures early in the winter than during midwinter. Fischer (1982) also noted an increase in the proportion of immatures as spring approached. The largest proportions of immatures reported in Illinois were at wildlife areas in southern Illinois (Sabine & Klimstra 1985). These observations support the concept that immature bald eagles move southward earlier and farther than adults. INHS census data collected over relatively large areas did not reveal such patterns of movements by immature bald eagles.

The accuracy of various methods of counting eagles has been debated. Southern (1964) reported that simultaneous ground and aerial counts gave similar results; he suggested that aerial counts validated the accuracy of ground counts. Harper (1983) found that aerial surveys gave consistently lower counts than ground counts in the same area. Havera et al. (1984) estimated that 75 to 90% of the eagles present were counted during aerial surveys.

Density of vegetation could easily affect the accuracy of observers when counting eagles from the ground or the air. Even under good conditions, immature bald eagles can be difficult to locate because of their mottled dark plumage. However, weather may have the greatest influence on the accuracy of bald eagle counts. Fog, rain, snow, and wind not only make it difficult for observers to see and age eagles but such conditions also may influence the activity of eagles, thereby making them less visible.

Difficulties in obtaining accurate determinations of eagle numbers in Illinois do not eliminate the value of such counts. The counts can identify important winter areas and document trends in bald eagle populations. The bald eagle inventories organized by Elton Fawks, for example, were prompted by concern over the low proportion of immatures seen in winter populations during the 1950s (Fawks 1983). After quickly increasing from 12.3% in 1961 to 27.6% in 1965, the proportion of immatures sighted on Fawks' counts has fluctuated slightly around a value of 30%. As with any migratory species, suitable winter habitat is essential to the survival of individuals and the subsequent reproductive success of the population.

NIGHT ROOSTS

Night roosts generally offered seclusion from human disturbance and protection from cold winds. At many of the roost sites, a windbreak was provided by the walls of a ravine or glen. On level areas, eagles selected trees for roosting that were protected by other trees (Fig. 28) (Fischer & Osterfeld 1981, Sabine & Klimstra 1985). Cottonwoods (*Populus deltoides*) were the preferred roost tree in some areas, and it appeared that size and configuration of available trees were important. Bald eagles generally selected trees that were taller than surrounding ones and had large, horizontal branches (Sabine & Klimstra 1985).

Although bald eagles perch and forage along major stretches of the Illinois and Mississippi rivers, relatively few areas have been identified and reported as night roosts (Fig. 29). Other undiscovered or unreported night roosts undoubtedly exist along the Illinois and Mississippi rivers. Dunstan and Fawks (1981) identified and described six night roosts as follows:

1) The Savanna Army Depot and nearby islands include about 13,000 acres (5,260 ha) in Jo Daviess and Carroll counties. Four specific night roost sites have been identified on the area. There are also recent records of nesting attempts on Depot property.

2) The Oak Valley Eagle Refuge in Rock Island County is owned and managed by the NWF and IDOC. There are four wooded ravines on the refuge that were used by roosting eagles.

3) Cedar Glen Eagle Roost (Fig. 15) is located in Hancock County between Hamilton and Warsaw. The roost and surrounding eagle foraging areas have been purchased and protected by a cooperative effort of the Illinois Chapter of The Nature Conservancy, IDOC, and Western Illinois University.

4) Pere Marquette State Park is located near the confluence of the Illinois and Mississippi rivers in Jersey County. The area around the park provides foraging and resting habitat, but most night roosting occurred in three hollows within the park.

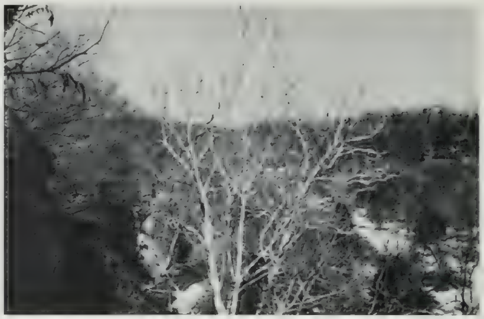

Fig. 28.–Crystal Glen Eagle Roost in Hancock County near Lock and Dam 19 on the Mississippi River. The sycamore (*Platanus occidentalis*) in the foreground was used by as many as 20 eagles nightly during January and February, 1979 (David L. Fischer, personal communication 1986). Houses built nearby during the summer of 1979 discouraged subsequent eagle use of this glen as a night roost (Photo by David L. Fischer).

5) Clarksville Island is located in the Mississippi River along Calhoun County. The island, owned by The Nature Conservancy, was used by eagles throughout the winter.

6) Burlington, Craigel, and Otter islands are located in the Mississippi River along Henderson County and each has a night roost. A variety of habitats appropriate for daytime use by bald eagles is available in the area.

Very few night roost areas along the Illinois River have been identified, mainly because of a lack of research. Robert Phelps, John Grigsby, and James Waycuilis (personal communications 1986) reported roosts in Putnam County near the Illinois River, at Rice Lake in Fulton County, and at Marshall County Conservation Area, respectively (Fig. 29). Additional night roosts likely occur in the vicinity of foraging areas such as Goose and Senachwine lakes, Peoria Lake, Chautauqua National Wildlife Refuge, and Sanganois Conservation Area. Roost areas were also identified at Union County and Horseshoe Lake Conservation areas and at CONWR (Sabine & Klimstra 1985) (Fig. 29).

RECENT BALD EAGLE NESTING

Bald eagles have constructed several nests in Illinois since 1973, and at least 16 eaglets fledged from these nests from 1978 to 1987 (Table 6). The first recent bald eagle nest in Illinois was built at CONWR in 1973. Eagles were seen at this nest again in 1974, but no eggs were laid in either of these years. A new nest was built at CONWR in 1979. One eaglet fledged from this nest in 1980 and two in 1981. In 1982, a second nest was constructed at CONWR. One nest

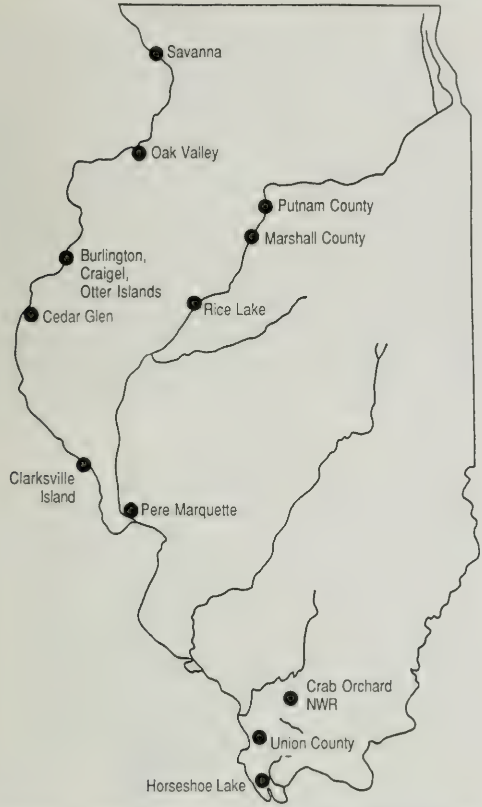

Fig. 29.–Locations of bald eagle night roosts identified by Dunstan and Fawks (1981), Sabine and Klimstra (1985), Robert Phelps (personal communication 1986), John Grigsby (personal communication 1986), and James Waycuilis (personal communication 1986).

was destroyed by high winds, but the other produced two young in 1982, two in 1983, and one in 1984. This second nest was blown to the ground in 1985 and no young were produced. Two nests were constructed at CONWR in the spring of 1987. Two young fledged from one nest, and one young fledged from the other. Two nests were also constructed at CONWR in the spring of 1987. Two young fledged from one nest and one young was killed in a storm just before fledging from the other nest.

Although CONWR has recently been the most productive eagle nesting area in Illinois, the first successful nest was at Horseshoe Lake in Alexander County. Two young were produced from a single nest at Horseshoe Lake in 1978. No subsequent nesting activity was observed in that area until 1987 when a new nest was constructed but no young were fledged.

Nesting activity has been seen at the Savanna Army Depot each year since 1978. A nest was constructed in 1978, enlarged in 1979, blown down in 1980, and replaced by a new nest in 1981. Eggs were laid and incubated in 1982, but it is not known if the eggs hatched. The nest was again destroyed by wind in 1983 and rebuilt in 1984. The first successful use of this nest was in 1985 when one eaglet fledged.

Other bald eagle nest construction has been seen at Union County Conservation Area in 1974 and 1980 and at Rend Lake in 1982 and 1983, but no young were produced from these nests.

Although bald eagles are occasionally seen during the late spring and summer months in the Illinois River valley, the first documented nesting of bald eagles in central Illinois occurred in 1986. A nest was established near the Illinois River in Pike County but was later abandoned. In 1987 a nest was built in Hancock County; however, it was also abandoned.

Table 6.—Bald eagle nesting activity in Illinois, 1973–1987.

Year	Number of Nests	Number of Young Fledged
1973	1	0
1974	2	0
1975	0	0
1976	0	0
1977	0	0
1978	2	2
1979	2	0
1980	3	1
1981	2	2
1982	4	2
1983	3	2
1984	2	1
1985	2	1
1986	3	3
1987	4	2

BALD EAGLE MORTALITY

A total of 36 bald eagles found dead in Illinois from 1963 to 1984 were submitted to federal laboratories for determination of cause of death. These birds died from a variety of causes, many of which are related to human activity (Table 7, NWHL 1985).

Like the nationwide data presented earlier, these mortality figures should be used as an index rather than as an accurate measure of the causes of eagle deaths in a population because it is difficult to collect a random sample. Shooting was the most common cause of death of bald eagles in Illinois, accounting for 11 (30.6%) of the deaths (Table 7). At least two more eagles were shot to death in 1985.

Six accidental deaths of bald eagles resulted from traumatic injuries, such as collisions with wires or vehicles (Table 7). Other causes of eagle deaths, such as electrocution, emaciation, and trapping, were of relatively minor importance in Illinois.

Six eagles also died from poisoning during this 22-year period in Illinois, and four of those six birds

Table 7.—Bald eagle mortality in Illinois, 1963–1984 (National Wildlife Health Laboratory 1985).

Cause of Death	Number of Mortalities	Percent of Total
Gunshot	11	30.6
Trauma (excluding gunshot, electrocution, and trapping)	6	16.7
Poisoning	6	16.7
Lead	4	11.1
Other	2	5.6
Electrocution	3	8.2
Emaciation	1	2.8
Trapping	1	2.8
Other,[a] Decomposed,[b] Open[c]	8	22.2

[a] Death attributed to some cause other than those listed.

[b] Carcass too badly decomposed for diagnosis.

[c] No apparent cause of death could be determined from necropsy examination and ancillary laboratory analyses.

were victims of secondary lead poisoning (Table 7). Waterfowl, especially crippled and dead birds, are a primary food item for bald eagles in some areas. Several species of waterfowl have been identified as food items for bald eagles in Illinois (Jonen 1973, Fischer 1982, Harper 1983, Sabine & Klimstra 1985). Feeding on waterfowl carcasses was usually accomplished by tearing the duck or goose apart with the beak while standing on the carcass (Fig. 30) (Sabine & Klimstra 1985).

The growing problem of secondary lead poisoning in eagles resulted in the requirement that nontoxic (steel) shot be used for waterfowl hunting in 10 Illinois counties in 1985. The prohibition of lead shot was expanded to 22 counties for the 1986 waterfowl season (U.S. Dept. of Interior 1986). IDOC modified the nontoxic shot zones for the 1986 waterfowl season to include primarily those areas that are used extensively by waterfowl and bald eagles (W. Anderson, personal communication 1986). This modification resulted in the prohibition of the use of lead shot for sport hunting of waterfowl in corridors along the Illinois and Mississippi rivers and in five entire counties, and in part of the Rend Lake area (Fig. 31). This corridor approach is supported by the findings of Havera and Kruse (1986) in their evaluation of the distribution of wintering bald eagles and waterfowl harvest in Illinois. Restrictions on the use of lead shot for waterfowl hunting in Illinois are part of a growing nationwide effort to reduce the availability of lead to eagles by reducing the number of dead and crippled waterfowl with lead shot embedded in their flesh or present in their digestive systems. The USFWS is moving towards a total nationwide ban on the use of lead shot for the hunting of waterfowl by the 1991–1992 hunting season (USFWS 1986).

SUMMARY

Continental numbers of bald eagles have increased since eagles achieved legal protection and since the prohibition of certain pesticides that affected reproductive success of eagles. Wintering bald eagles are attracted to Illinois by the availability of food, primarily fish. Wintering eagles generally appeared in early to mid-October in the northern and central regions of Illinois and during late October in the southern regions. Eagles usually had departed Illinois by mid-April. Numbers of wintering bald eagles sighted in Illinois during the midwinter inventory have increased since its inception in 1957, and the highest number censused by INHS was 1,217 on 6–7 January

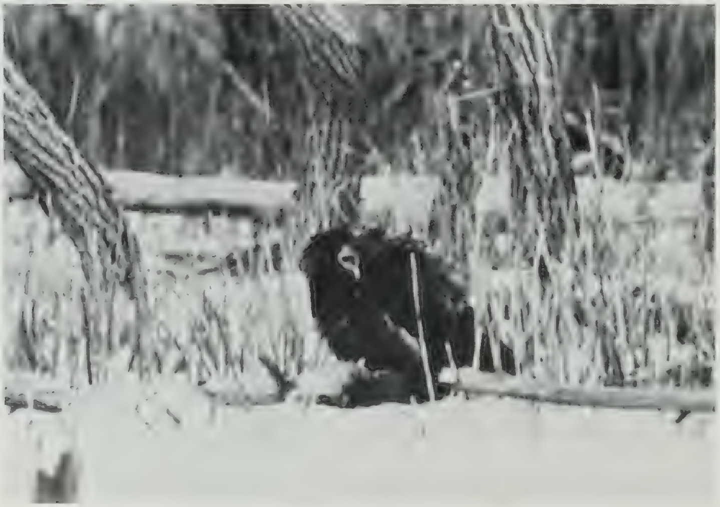

Fig. 30.—Immature bald eagle feeding on a dead Canada goose (Photo by Timothy Smalley, Minnesota Department of Natural Resources).

1986. The proportion of immature eagles counted by INHS during the midwinter inventory typically ranged between 30 and 37%.

The Illinois and Mississippi river floodplains and the Canada goose refuges in southern Illinois hosted a majority of bald eagles wintering in the state. The mean number of eagles seen per inventory was highest for the Upper Mississippi River Region with values ranging from 4.1 to 20.9 eagles per flight at the various areas censused. Six of the 11 areas censused in the Upper Mississippi River Region had an average of more than 10 bald eagles per inventory. By comparison, only four areas in the 10 other regions censused throughout Illinois, (the Keokuk–Meyer, Grand Tower–Cape Girardeau, and Cape Girardeau–Cairo stretches of the Mississippi River and the Flat and Swan lakes area near the confluence of the Illinois and Mississippi rivers) had values exceeding 10.0 for the mean number of eagles per inventory. The Upper Mississippi River Region was censused for just 3 years (1980–1983), and only the Kaskaskia River Region had fewer inventories.

Values for the estimated density of bald eagles per river mile and per square mile of wetlands, respectively, for the inventory regions of the Mississippi and Illinois rivers were Upper Mississippi, 1.38 and 0.96; Upper Central Mississippi, 0.46 and 0.36; Lower Central Mississippi, 0.48 and 0.34; Lower Mississippi, 0.24 and 0.20; Upper Illinois, 0.20 and 0.47; Central Illinois, 0.67 and 0.47; and Lower Illinois, 0.56 and 0.49. Fewer bald eagles were observed in the Surface-mined Lakes Region in west-central Illinois, the Northeast Lakes Region, the Central and Southern Lakes Region, and the Lower Kaskaskia River Region.

Intensified enforcement of laws protecting bald eagles, the protection and management of habitats identified as feeding, roosting, and major eagle use areas, and the reduction of the availability of lead shot to eagles should result in an increase in the number of bald eagles that winter in Illinois.

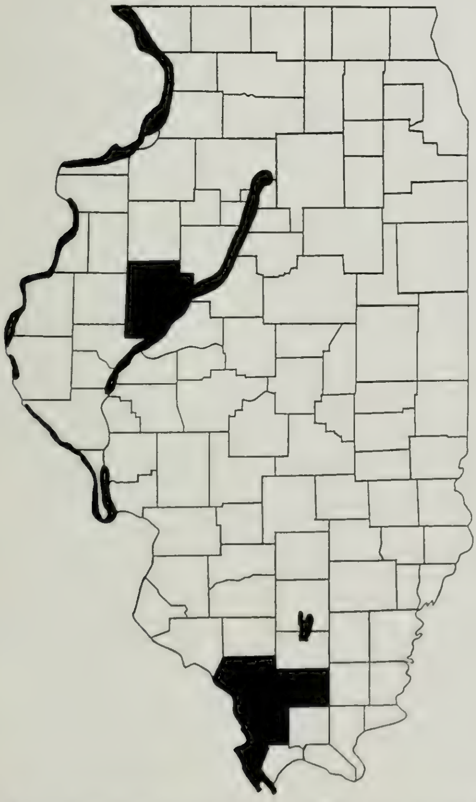

Fig. 31.–Illinois nontoxic shot zones for the 1986 waterfowl hunting season.

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APPENDIX

Aerial inventory areas by region, number of inventories, mean number of bald eagles counted per inventory, and maximum number of eagles censused during a single inventory at each area for all census years. (Number of years of inventories in each region is listed in Table 4.) Asterisks indicate areas located in the Illinois River floodplain but inventoried as part of the Lower Central Mississippi River Region.

Inventory Area	Number of Inventories[a]	Mean Number of Eagles Per Inventory[a]	Maximum Number of Eagles Censused
Upper Mississippi River Region			
Dubuque–Galena River	22	6.5	25
Galena River–Bellevue	22	7.4	31
Bellevue–Green Island	22	16.4	39
Green Island–Savanna	22	11.8	28
Spring Lake Refuge	23	5.5	13
Elk River Refuge	22	4.1	18
Elk River–Fulton	23	11.3	23
Fulton–Albany	23	15.0	47
Albany–Wapsipinicon River	23	11.6	29
Wapsipinicon River–Princeton	23	20.9	68
Princeton–Interstate 80	23	7.4	28
Upper Central Mississippi River Region			
Andalusia Refuge	49	1.8	47
Moline–Muscatine	124	4.9	27
Muscatine–Louisa	125	5.1	30
Louisa Refuge	127	5.1	24
New Boston	127	1.2	19
Keithsburg Refuge	131	2.9	14
Keithsburg–Oquawka	131	5.6	28
Oquawka Refuge	127	2.0	13
Crystal Lake	127	0.5	11
Oquawka–Burlington	131	5.5	52
Turkey Slough	128	0.9	8
Burlington–Dallas City	132	5.6	29
Dallas City–Fort Madison	133	4.9	19
Fort Madison–Nauvoo	133	7.5	37
Arthur Refuge	129	<0.1	3
Nauvoo–Keokuk	133	6.7	35
Lower Central Mississippi River Region			
Keokuk–Meyer	130	11.7	90
Gardner Refuge	127	2.3	18
Meyer–Quincy	131	6.8	90
Quincy–Hannibal	125	5.0	57
Gardner Club	116	<0.1	3
Hannibal–Saverton	128	4.1	40
Shanks Refuge	126	2.9	18
Saverton–Louisiana	129	5.2	46
Delair Refuge	126	3.0	15
Sny Slough	127	0.8	39
Calumet Refuge	127	0.8	12
Duck Club	125	0.1	4
Cannon Refuge	126	2.8	13
Gilead	125	0.7	7
Batchtown Refuge	123	3.0	18
Batchtown Pool	123	6.3	52
Cuivre	124	2.1	16

APPENDIX (continued)

Inventory Area	Number of Inventories[a]	Mean Number of Eagles Per Inventory[a]	Maximum Number of Eagles Censused
Dardenne	124	3.8	26
Marais Temps Clair	124	1.1	13
Hager	123	1.3	9
Grafton–Alton	126	2.0	20
Gilbert Lake*	127	2.8	13
Flat Lake, Swan Lake*	127	13.6	269
Stump Lake*	128	1.8	18
Godar Swamp*	131	0.7	10
Lower Mississippi River Region			
Horseshoe Lake	108	0.9	8
St. Louis–Kimmswick	109	0.8	13
Kimmswick–Crystal City	109	1.8	20
Crystal City–Ste. Genevieve	109	3.6	25
Ste. Genevieve–Chester	109	6.0	38
Chester–Grand Tower	109	8.5	46
Grand Tower–Cape Girardeau	108	12.5	53
Cape Girardeau–Cairo	105	15.1	64
Upper Illinois River Region			
Morris–Seneca	11	2.4	8
Seneca–Marseilles	59	0.6	5
Marseilles–Utica	59	1.6	10
Utica–La Salle	59	2.4	12
La Salle–Spring Valley	59	4.4	21
Central Illinois River Region			
Turner Lake	123	0.5	6
Depue Lake, Spring Lake	123	0.8	11
Coleman Lake	123	1.2	11
Bureau Ponds	124	<0.1	4
Goose Lake	125	6.6	26
Senachwine Lake	125	4.8	20
Siebold Lake	125	0.9	6
Sawmill Lake	125	0.7	8
Billsbach Lake	125	2.4	12
Weis Lake	125	1.5	15
Sparland Lake	125	0.1	3
Wightman Lake	125	<0.1	3
Sawyer Slough	125	0.9	8
Hitchcock Slough	125	3.8	14
Round Pond	123	0.8	7
Meadow Lake	123	<0.1	1
Rice Pond	124	3.8	19
Goose Pond	125	2.3	23
Upper Peoria Lake	125	6.0	24
Lower Peoria Lake	122	1.3	10
Lower Illinois River Region			
Pekin Lake	128	2.1	9
Powerton Lake	137	3.9	34
Spring Lake	108	0.4	7
Banner Marsh	122	0.8	6
Duck Creek Cooling Lake	120	1.8	17

APPENDIX (continued)

Inventory Area	Number of Inventories[a]	Mean Number of Eagles Per Inventory[a]	Maximum Number of Eagles Censused
Rice Lake	134	2.2	11
Big Lake	134	3.0	14
Goose Lake	131	0.8	9
Clear Lake	134	6.0	28
Chautauqua Lake	135	9.4	35
Quiver Creek	136	4.1	23
Quiver Lake	110	0.7	10
Bath Lake	127	1.0	11
Grass Lake	133	1.6	10
Anderson Lake	134	1.3	9
Moscow Bay	135	0.9	9
Jack Lake	135	5.2	23
Snicarte Slough	135	0.6	7
Ingram Lake	135	1.8	13
Stewart Lake	132	0.9	11
Crane Lake	134	8.1	29
Cuba Island	133	5.5	40
Chain Lake	133	2.0	16
Sangamon Delta	132	4.3	33
Treadway Lake	132	1.1	12
Muscooten Bay	69	0.2	3
Big Prairie Lake	131	0.9	12
Meredosia Lake	133	4.9	25
Smith Lake	130	0.6	11
Central and Southern Lakes Region			
DeWitt County			
Clinton Lake	14	0.0	0
Sangamon County			
Lake Springfield	56	0.8	7
Christian County			
Lake Sangchris	59	0.3	3
Montgomery County			
Coffeen Lake	41	0.4	5
Shelby and Moultrie counties			
Lake Shelbyville	31	0.4	3
Jasper County			
Newton Lake	26	0.6	6
Clinton and Fayette counties			
Carlyle Lake	56	2.2	9
Jefferson and Franklin counties			
Rend Lake	55	1.8	9
Randolph County			
Baldwin Lake	58	0.4	5
Northeast Lakes Region			
McHenry County			
McHenry Dam vicinity	31	1.4	7
Wonder Lake	28	0.3	3
Woodstock Ponds	28	0.0	0
Pistakee Bay	30	0.2	5
Lake County			
Fox Lake	30	0.3	3

APPENDIX (continued)

Inventory Area	Number of Inventories[a]	Mean Number of Eagles Per Inventory[a]	Maximum Number of Eagles Censused
Grass Lake	30	0.3	6
Antioch–Lake Villa	30	0.0	0
De Kalb County			
Shabbona Lake	25	0.0	0
Cook County			
Crabtree Nature Area	31	0.3	3
Baker Lake vicinity	31	<0.1	1
McGinnis Slough vicinity	42	0.9	5
McGinnis–Calumet	40	0.2	3
Will County			
Des Plaines Wildlife Area	46	<0.1	3
Rendwick Lake vicinity	41	<0.1	1
Grundy County			
Dresden Lake	47	0.2	5
Goose Lake Prairie	47	0.6	6
Collins Lake	47	0.5	6
Braidwood Lake	44	0.5	5
La Salle County			
Seneca Lake	45	0.2	3
Surface-mined Lakes Region			
Knox County			
Victoria vicinity	16	0.0	0
Rapatee vicinity	22	0.0	0
Peabody property	22	0.0	0
Fulton County			
Norris vicinity	22	0.0	0
Fairview vicinity	22	0.0	0
Fin and Feather property	22	0.0	0
CILCO property	23	2.3	10
Buckheart property	23	0.5	2
Cebuhar property	23	0.0	0
Justice property	23	0.0	0
Metropolitan Sanitary District property	23	0.3	3
Fulton County Conservation Area	23	0.0	0
Cuba vicinity	23	0.0	0
Wee-Ma-Tuk property	23	0.0	0
Red Barn property	23	0.0	0
Giant Goose Ranch property	23	0.0	0
Lower Kaskaskia River Region			
Fayetteville–New Athens	7	0.0	0
New Athens–Rt. 154	7	0.1	1
Rt. 154–Evansville	7	0.3	2
Evansville–Chester	7	1.4	6

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[a] Based on the period between the first sighting of a bald eagle in the fall of each year and the last sighting in the following spring, and not the entire census period from fall through spring.

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